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VOL. LV, No. 1412

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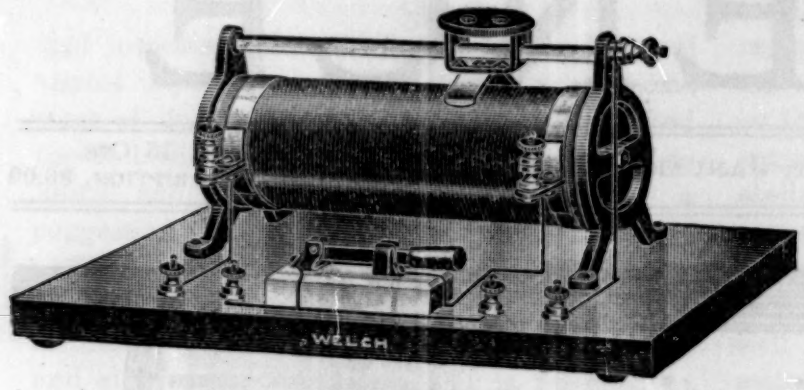

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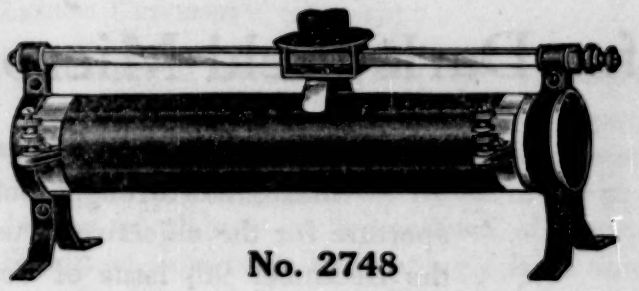

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EVOLUTIONARY FAITH AND MODERN DOUBTS[1]

I VISIT Canada for the first time in delightful circumstances. After a period of dangerous isolation, intercourse between the centres of scientific development is once more beginning, and I am grateful to the American Association for this splendid opportunity of renewing friendship with my western colleagues in genetics, and of coming into even a temporary partnership in the great enterprise which they have carried through with such extraordinary success.

In all that relates to the theme which I am about to consider we have been passing through a period of amazing activity and fruitful research. Coming here after a week in close communion with the wonders of Columbia University, I may seem behind the times in asking you to devote an hour to the old topic of evolution. But though that subject is no longer in the forefront of debate, I believe it is never very far from the threshold of our minds, and it was with pleasure that I found it appearing in conspicuous places in several parts of the program of this meeting.

Standing before the American Association, it is not unfit that I should begin with a personal reminiscence. In 1883 I first came to the United States to study the development of Balanoglossus at the Johns Hopkins summer laboratory, then at Hampton, Va. This creature had lately been found there in an easily accessible place. With a magnanimity, that on looking back I realize was superb, Professor W. K. Brooks had given me permission to investigate it, thereby handing over to a young stranger one of the prizes which in this age

[1] Delivered before the American Association for the Advancement of Science on Wednesday evening, December 28, in the Convocation Hall of the University of Toronto.

of more highly developed patriotism, most teachers would keep for themselves and their own students. At that time one morphological laboratory was in purpose and aim very much like another. Morphology was studied because it was the material believed to be most favorable for the elucidation of the problems of evolution, and we all thought that in embryology the quintessence of morphological truth was most palpably presented. Therefore every aspiring zoologist was an embryologist, and the one topic of professional conversation was evolution. It had been so in our Cambridge school, and it was so at Hampton.

I wonder if there is now a single place where the academic problems of morphology which we discussed with such avidity can now arouse a moment's concern. There were of course men who saw a little further, notably Brooks himself. He was at that time writing a book on heredity, and, to me at least, the notion on which he used to expatiate, that there was a special physiology of heredity capable of independent study, came as a new idea. But no organized attack on that problem was begun, nor had any one an inkling of how to set about it. So we went on talking about evolution. That is barely 40 years ago; to-day we feel silence to be the safer course.

Systematists still discuss the limits of specific distinction in a spirit, which I fear is often rather scholastic than progressive, but in the other centers of biological research a score of concrete and immediate problems have replaced evolution.

Discussions of evolution came to an end primarily because it was obvious that no progress was being made. Morphology having been explored in its minutest corners, we turned elsewhere. Variation and heredity, the two components of the evolutionary path, were next tried. The geneticist is the successor of the morphologist. We became geneticists in the conviction that there at least must evolutionary wisdom be found. We got on fast. So soon as a critical study of variation was undertaken, evidence came in as to the way in which varieties do actually arise in descent. The unacceptable doctrine of the secular transformation of masses by the accumulation of impalpable changes became not only unlikely but gratuitous. An examination in the field of the interrelations of pairs of well characterized but closely allied "species" next proved, almost wherever such an inquiry could be instituted, that neither could both have been gradually evolved by natural selection from a common intermediate progenitor, nor either from the other by such a process. Scarcely ever where such pairs co-exist in nature, or occupy conterminous areas do we find an intermediate normal population as the theory demands. The ignorance of common facts bearing on this part of the inquiry which prevailed among evolutionists, was, as one looks back, astonishing and inexplicable. It had been decreed that when varieties of a species co-exist in nature, they must be connected by all intergradations, and it was an article of faith of almost equal validity that the intermediate form must be statistically the majority, and the extremes comparatively rare. The plant breeder might declare that he had varieties of Primula or some other plant, lately constituted, uniform in every varietal character breeding strictly true in those respects, or the entomologist might state that a polymorphic species of a beetle or of a moth fell obviously into definite types, but the evolutionary philosopher knew better. To him such statements merely showed that the reporter was a bad observer, and not improbably a destroyer of inconvenient material. Systematists had sound information but no one consulted them on such matters or cared to hear what they might have to say. The evolutionist of the eighties was perfectly certain that species were a figment of the systematist's mind, not worthy of enlightened attention.

Then came the Mendalian clue. We saw the varieties arising. Segregation maintained their identity. The discontinuity of variation was recognized in abundance. Plenty of the Mendelian combinations would in nature pass the scrutiny of even an exacting systematist and be given "specific rank." In the light of such facts the origin of species was no doubt a similar phenomenon. All was clear ahead.

But soon, though knowledge advanced at a great rate, and though whole ranges of phenomena which had seemed capricious and disorderly fell rapidly into a co-ordinated system, less and less was heard about evolution in genetical circles, and now the topic is dropped. When students of other sciences ask us what is now currently believed about the origin of species we have no clear answer to give. Faith has given place to agnosticism for reasons which on such an occasion as this we may profitably consider.

Where precisely has the difficulty arisen? Though the reasons for our reticence are many and present themselves in various forms, they are in essence one; that as we have come to know more of living things and their properties, we have become more and more impressed with the inapplicability of the evidence to these questions of origin. There is no apparatus which can be brought to bear on them which promises any immediate solution.

In the period I am thinking of it was in the characteristics and behavior of animals and plants in their more familiar phases, namely, the Zygotic phases that attention centered. Genetical research has revealed the world of gametes from which the zygotes—the products of fertilization are constructed. What has been there witnessed is of such extraordinary novelty and so entirely unexpected that in presence of the new discoveries we would fain desist from speculation for a while. We see long courses of analysis to be traveled through and for some time to come that will be a sufficient occupation. The evolutionary systems of the eighteenth and nineteenth centuries were attempts to elucidate the order seen prevailing in this world of zygotes and to explain it in simpler terms of cause and effect: we now perceive that that order rests on and is determined by another equally significant and equally in need of "explanation." But if we for the present drop evolutionary speculation it is in no spirit of despair. What has been learned about the gametes and their natural history constitutes progress upon which we shall never have to go back. The analysis has gone deeper than the most sanguine could have hoped.

We have turned still another bend in the track and behind the gametes we see the chromosomes. For the doubts—which I trust may be pardoned in one who had never seen the marvels of cytology, save as through a glass darkly—can not as regards the main thesis of the Drosophila workers, be any longer maintained. The arguments of Morgan and his colleagues, and especially the demonstrations of Bridges, must allay all scepticism as to the direct association of particular chromosomes with particular features of the zygote. The transferable characters borne by the gametes have been successfully referred to the visible details of nuclear configuration.

The traces of order in variation and heredity which so lately seemed paradoxical curiosities have led step by step to this beautiful discovery. I come at this Christmas Season to lay my respectful homage before the stars that have arisen in the west. What wonder if we hold our breath? When we knew nothing of all this the words came freely. How easy it all used to look! What glorious assumptions went without rebuke. Regardless of the obvious consideration that "modification by descent" must be a chemical process, and that of the principles governing that chemistry science had neither hint, nor surmise, nor even an empirical observation of its working, professed men of science offered very confidently positive opinions on these nebulous topics which would now scarcely pass muster in a newspaper or a sermon. It is a wholesome sign of return to sense that these debates have been suspended.

Biological science has returned to its rightful place, investigation of the structure and properties of the concrete and visible world. We cannot see how the differentiation into species came about. Variation of many kinds, often considerable, we daily witness, but no origin of species. Distinguishing what is known from what may be believed we have absolute certainty that new forms of life, new orders and new species have arisen on the earth. That is proved by the paleontological

record. In a spirit of paradox even this has been questioned. It has been asked how do you *know* for instance that there were no mammals in palæozoic times? May there not have been mammals somewhere on the earth though no vestige of them has come down to us? We may feel confident there were no mammals then, but are we sure? In very ancient rocks most of the great orders of animals are represented. The absence of the others might by no great stress of imagination be ascribed to accidental circumstances.

Happily however there is one example of which we can be sure. There were no Angiosperms—that is to say "higher plants" with protected seeds—in the carboniferous epoch. Of that age we have abundant remains of a world wide and rich flora. The Angiosperms are cosmopolitan. By their means of dispersal they must immediately have become so. Their remains are very readily preserved. If they had been in existence on the earth in carboniferous times they must have been present with the carboniferous plants, and must have been preserved with them. Hence we may be sure that they did appear on the earth since those times. We are not certain, using certain in the strict sense, that the Angiosperms are the lineal descendants of the carboniferous plants, but it is very much easier to believe that they are than that they are not.

Where is the difficulty? If the Angiosperms came from the carboniferous flora why may we not believe the old comfortable theory in the old way? Well so we may if by belief we mean faith, the substance, the foundation of things hoped for, the evidence of things not seen. In dim outline evolution is evident enough. From the facts it is a conclusion which inevitably follows. But that particular and essential bit of the theory of evolution which is concerned with the origin and nature of *species* remains utterly mysterious. We no longer feel as we used to do, that the process of variation, now contemporaneously occurring, is the beginning of a work which needs merely the element of time for its completion; for even time can not complete that which has not yet begun. The conclusion in which we were brought up, that species are a product of a summation of variations ignored the chief attribute of species first pointed out by John Ray that the product of their crosses is frequently sterile in greater or less degree. Huxley, very early in the debate pointed out this grave defect in the evidence, but before breeding researches had been made on a large scale no one felt the objection to be serious. Extended work might be trusted to supply the deficiency. It has not done so, and the significance of the negative evidence can no longer be denied.

When Darwin discussed the problem of inter-specific sterility in the "Origin of Species" this aspect of the matter seems to have escaped him. He is at great pains to prove that inter-specific crosses are *not always* sterile, and he shows that crosses between forms which pass for distinct species may produce hybrids which range from complete fertility to complete sterility. The fertile hybrids he claims in support of his argument. If species arose from a common origin, clearly they should not always give sterile hybrids. So Darwin is concerned to prove that such hybrids are by no means always sterile, which to us is a commonplace of everyday experience. If species have a common origin, where did they pick up the ingredients which produce this sexual incompatibility? Almost certainly it is a variation in which something has been added. We have come to see that variations can very commonly—I do not say always—be distinguished as positive and negative. The validity of this distinction has been doubted, especially by the *Drosophila* workers. Nevertheless in application to a very large range of characters, I am satisfied that the distinction holds, and that in analysis it is a useful aid. Now we have no difficulty in finding evidence of variation by loss. Examples abound, but variation by addition are rarities, even if there are any which must be so accounted. The variations to which interspecific sterility is due are obviously variations in which something is apparently added to the stock of ingredients. It is one of the common experiences of the breeder that when

a hybrid is partially sterile, and from it any fertile offspring can be obtained, the sterility, once lost, disappears. This has been the history of many, perhaps most of our cultivated plants of hybrid origin.

The production of an indubitably sterile hybrid from completely fertile parents which have arisen under critical observation from a single common origin is the event for which we wait. Until this event is witnessed, our knowledge of evolution is incomplete in a vital respect. From time to time a record of such an observation is published, but none has yet survived criticism. Meanwhile, though our faith in evolution stands unshaken, we have no acceptable account of the origin of "species."

Curiously enough, it is at the same point that the validity of the claim of natural selection as the main directing force was most questionable. The survival of the fittest was a plausible account of evolution in broad outline, but failed in application to specific difference. The Darwinian philosophy convinced us that every species must "make good" in nature if it is to survive, but no one could tell how the differences—often very sharply fixed—which we recognize as specific, do in fact enable the species to make good. The claims of natural selection as the chief factor in the determination of species have consequently been discredited.

I pass to another part of the problem, where again, though extraordinary progress in knowledge has been made, a new and formidable difficulty has been encountered. Of variations we know a great deal more than we did. Almost all that we have seen are variations in which we recognize that elements have been lost. In addressing the British Association in 1914 I dwelt on evidence of this class. The developments of the last seven years, which are memorable as having provided in regard to one animal, the fly Drosophila, the most comprehensive mass of genetic observation yet collected, serve rather to emphasize than to weaken the considerations which I then referred. Even in Drosophila, where hundreds of genetically distinct factors have been identified, very few new dominants, that is to say positive additions, have been seen, and I am assured that none of them are of a class which could be expected to be viable under natural conditions. I understand even that none are certainly viable in the homozygous state.

If we try to trace back the origin of our domesticated animals and plants, we can scarcely ever point to a single wild species as the probable progenitor. Almost every naturalist who has dealt with these questions in recent years has had recourse to theories of multiple origin, because our modern races have positive characteristics which we cannot find in any existing species, and which combination of the existing species seem unable to provide. To produce our domesticated races it seems that ingredients must have been added. To invoke the hypothetical existence of lost species provides a poor escape from this difficulty, and we are left with the conviction that some part of the chain of reasoning is missing. The weight of this objection will be most felt by those who have most experience in practical breeding. I can not, for instance, imagine a round seed being found on a wrinkled variety of pea except by crossing. Such seeds, which look round, sometimes appear, but this is a superficial appearance, and either these seeds are seen to have the starch of wrinkled seeds or can be proved to be the produce of stray pollen. Nor can I imagine a fern-leaved Primula producing a palm-leaf, or a star-shaped flower producing the old type of *sinensis* flower. And so on through long series of forms which we have watched for twenty years.

Analysis has revealed hosts of transferable characters. Their combinations suffice to supply in abundance series of types which might pass for new species, and certainly would be so classed if they were met with in nature. Yet critically tested, we find that they are not distinct species and we have no reason to suppose that any accumulations of characters of the same order would culminate in the production of distinct species. Specific difference therefore must be regarded as probably attaching to the base upon which these transferables are implanted, of which we know absolutely

nothing at all. Nothing that we have witnessed in the contemporary world can colorably be interpreted as providing the sort of evidence required.

Twenty years ago, de Vries made what looked like a promising attempt to supply this so far as *Oenothera* was concerned. In the light of modern experiments, especially those of Renner, the interest attaching to the polymorphism of *Oenothera* has greatly developed, but in application to that phenomenon the theory of mutation falls. We see novel forms appearing, but they are no new species of *Oenothera,* nor are the parents which produce them pure or homozygous forms. Renner's identification of the several complexes allocated to the male and female sides of the several types is a wonderful and significant piece of analysis introducing us to new genetical conceptions. The Oenotheras illustrate in the most striking fashion how crude and inadequate are the suppositions which we entertained before the world of gametes was revealed. The appearance of the plant tells us little or nothing of these things. In Mendelism, we learnt to appreciate the implication of the fact that the organism is a double structure, containing ingredients derived from the mother and from the father respectively. We have now to admit the further conception that between the male and female sides of the same plant these ingredients may be quite differently apportioned, and that the genetical composition of each may be so distinct that the systematist might without extravagance recognize them as distinct specifically. If then our plant may by appropriate treatment be made to give off two distinct forms, why is not that phenomenon a true instance of Darwin's origin of species? In Darwin's time it must have been acclaimed as exactly supplying all and more than he ever hoped to see. We know that that is not the true interpretation. For that which comes out is no new creation.

Only those who are keeping up with these new developments can fully appreciate their vast significance or anticipate the next step. That is the province of the geneticist. Nevertheless, I am convinced that biology would greatly gain by some cooperation among workers in the several branches. I had expected that genetics would provide at once common ground for the systematist and the laboratory worker. This hope has been disappointed. Each still keeps apart. Systematic literature grows precisely as if the genetical discoveries had never been made and the geneticists more and more withdraw each into his special "claim" —a most lamentable result. Both are to blame. If we cannot persuade the systematists to come to us, at least we can go to them. They too have built up a vast edifice of knowledge which they are willing to share with us, and which we greatly need. They too have never lost that longing for the truth about evolution which to men of my date is the salt of biology, the impulse which made us biologists. It is from them that the raw materials for our researches are to be drawn, which alone can give catholicity and breadth to our studies. We and the systematists have to devise a common language.

Both we and the systematists have everything to gain by a closer alliance. Of course we must specialize, but I suggest to educationists that in biology at least specialization begins too early. In England certainly harm is done by a system of examinations discouraging to that taste for field natural history and collecting, spontaneous in so many young people. How it may be on this side, I can not say, but with us attainments of that kind are seldom rewarded, and are too often despised as trivial in comparison with the stereotyped biology which can be learnt from text-books. Nevertheless, given the aptitude, a very wide acquaintance with nature and the diversity of living things may be acquired before the age at which more intensive study must be begun, the best preparation for research in any of the branches of biology.

The separation between the laboratory men and the systematists already imperils the work, I might almost say the sanity, of both. The systematists will feel the ground fall from beneath their feet, when they learn and realize what genetics has accomplished, and we, close students of specially chosen examples, may

find our eyes dazzled and blinded when we look up from our work-tables to contemplate the brilliant vision of the natural world in its boundless complexity.

I have put before you very frankly the considerations which have made us agnostic as to the actual mode and processes of evolution. When such confessions are made the enemies of science see their chance. If we cannot declare here and now how species arose, they will obligingly offer us the solutions with which obscurantism is satisfied. Let us then proclaim in precise and unmistakable language that our faith in evolution is unshaken. Every available line of argument converges on this inevitable conclusion. The obscurantist has nothing to suggest which is worth a moment's attention. The difficulties which weigh upon the professional biologist need not trouble the layman. Our doubts are not as to the reality or truth of evolution, but as to the origin of *species,* a technical, almost domestic, problem. Any day that mystery may be solved. The discoveries of the last twenty-five years enable us for the first time to discuss these questions intelligently and on a basis of fact. That synthesis will follow on an analysis, we do not and cannot doubt.

WILLIAM BATESON
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THE AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE

THE MAIN FEATURES OF THE PROCEEDINGS OF THE COUNCIL AT THE TORONTO MEETING

THE Treasurer's report for 1921 was accepted and will be published in SCIENCE. It shows that the total endowment funds of the Association now amount to $121,414.77.

The Permanent Secretary's financial report for the fiscal year 1920-21 was accepted and will also be published in SCIENCE. The total income of the permanent secretary's office for the fiscal year was $56,463.20.

The council appropriated the sum of $4,000 from the treasurer's appropriable funds, to be allotted as grants for research, according to the recommendations of the Committee on Grants; and it also appropriated $500 from the same funds, to be refunded by the treasurer to the permanent secretary, on account of a $500 grant made from the permanent secretary's funds early in 1921.

The council voted (A) that the treasurer should, now and in the future, invest in securities only additions to the permanent funds, and that he should invest these additions as soon as practicable after their receipt by him; (B) that the treasurer should hold available for appropriation by the council all income from capital funds; and (C) that the balance of the income now available for grants for research after deducting the disbursements for this purpose ($4,500) authorized above, should be held by the treasurer as an emergency research fund available for appropriation by the council as grants for research. (By previous action of the council the treasurer pays annually to the permanent secretary a sum amounting to $3 for each life or sustaining member still living, on account of the journal).

The budgets for 1922 of the permanent secretary, the general secretary, and the treasurer were approved.

The action of the executive committee was approved, in the following elections to membership in the Finance Committee: A. S. Frissell, New York, N. Y.; Milton E. Ailes, Washington, D. C. The Treasurer, R. S. Woodward, is chairman of the Finance Committee.

The action of the executive committee was approved in the election of the following members to emeritus life-membership on account of the Jane M. Smith Fund: Professor B. K. Emerson (M 70, F 77), Amherst, Mass.; Professor Eugene A. Smith (M 71, F 77), University, Ala.

Forty-eight members were elected to fellowship in the association, on nominations duly approved by the section secretaries.

The council expressed by a rising vote its appreciation of the fact that Past President T. C. Mendenhall, who presided at the first Toronto meeting of the Association, in 1889, had found it possible to be present at the sec-

ond Toronto meeting and to take part in the deliberations of the council.

It was voted that the fourth Boston meeting of the Association (for the fiscal year 1922-23) shall occur from December 26 to 30, 1922, inclusive.

It was voted that the annual meeting for 1923-24 shall occur at Cincinnati, and that the annual meeting for 1924-25 shall occur at Washington.

The council asked the general secretary to take up with the Pacific Division the question of a joint meeting of that division and the association in the summer of 1922, and this question was referred to the executive committee with power.

The report of the secretary of the Committee on Grants, showing a complete history of the work of this committee, was accepted and ordered to be printed in SCIENCE. This report will be published later.

On recommendation of the secretary of the Commitee on Grants the council voted that the records of the Committee on Grants shall hereafter be kept in the permanent secretary's office.

Seven resolutions bearing on the general welfare were adopted, and these are published in the present issue of SCIENCE.

The council elected the president and the vice-presidents for the sections, for 1922. These elections have already been reported in SCIENCE (Vol. 55, p. 15-16, Jan. 6, 1922.).

The council elected three council members and two members of the Executive Committee; and the president appointed, on recommendation of the council, three members of the Commitee on Grants. The names of these officers are published in SCIENCE.

On vote of the council, the president was to appoint a committee to consider the general question of convocation week (the week in which New Year's Day falls) as the time for the annual meetings of the Association, this committee to consist of: J. McKeen Cattell, *Chairman*; E. H. Moore; and three others.

On vote by the council, the president appointed the following committee to consider the subject of reciprocity between the United States and Canada, as this concerns scientific work: E. L. Nichols, *chairman*; F. D. Adams; T. C. Chamberlin; J. C. Fields; J. C. Merriam.

The report of the Committee on An International Auxiliary Language was accepted, and the resolutions at the end of this report were adopted by the council. These are published in this issue of SCIENCE.

The general secretary was directed to transmit a vote of thanks to the institutions that have acted as hosts for the Toronto meeting.

The council passed a vote of thanks to President E. H. Moore, in appreciation of his tactful and efficient service as chairman of the council during the Toronto sessions.

The executive committee of the council voted that no specially printed program for any section (aside from those included in the general program) can be paid for from the Permanent Secretary's funds without special authorization beforehand.

The executive committee approved the plan of having the assistant secretary go to the meeting place before the meeting, in time to care for the publication of the general program, etc.

The executive committee voted that the chairman of the Committee on the History of Science shall act as vice-president for Section L for 1922, and that the secretary of that committee shall act as secretary of Section L for 1922. It was also voted that the Committee on the History of Science shall act as the Section Committee for Section L for 1922.

BURTON E. LIVINGSTON,
Permanent Secretary.

RESOLUTIONS ADOPTED BY THE COUNCIL

Seven resolutions bearing on the general welfare of American peoples were adopted by the Council of the American Association for the Advancement of Science at the Second Toronto Meeting, December 27-31, 1921. These resolutions follow:

A resolution on the desirability of the duty-free importation of scientific materials and apparatus by educational and research institutions in the United States, adopted by the Ex-

ecutive Committee of the Council of the American Association for the Advancement of Science at the regular spring meeting of the committee, April 24, 1921, and approved and officially adopted by the Council at the Toronto meeting, December 29, 1921.

[The text of this resolution was published in SCIENCE for May 27, 1921.]

A Resolution Bearing on the U. S. Forest Service and the U. S. National Forests.

WHEREAS, The transfer of the U. S. Forest Service and National Forests from the Department of Agriculture to the Department of the Interior has been proposed in connection with the reorganization of the U. S. government departments, and is embodied in certain bills before Congress (S2740, and S2382, S2203);

WHEREAS, This proposed transfer ignores the connection between forestry and agriculture, and the essential dependence of the Forest Service upon the various activities of the Department of Agriculture, such as the work on soils, and on the control of plant diseases and insect pests, as well as plant and animal investigations, and so forth;

WHEREAS, The scientific and administrative functions of the Forest Service are so interdependent that a splitting up of the Forest Service would seriously impair its efficiency;

WHEREAS, A large proportion of the forest land of the U. S. is on farms, and would require the attention of the Department of Agriculture in any case, and thus the proposed transfer would give rise to a duplication in the government departments such that the main purpose of the transfer would be defeated;

WHEREAS, The rapidly diminishing timber resources of the country make strong leadership in forestry, such as that provided by the Forest Service, a matter of vital public concern;

WHEREAS, The National Forests were placed under the Department of Agriculture by President Roosevelt to insure their development along sound lines, and have since been managed by the Forest Service with an exceptionally high degree of efficiency in the best interests of the local communities and of the country as a whole; and

WHEREAS, The proposed transfer would be a distinct backward step in a matter affecting the general welfare;

THEREFORE, BE IT RESOLVED, That the American Association for the Advancement of Science strongly disapproves and vigorously opposes any action by which the Forest Service or the National Forests of the United States or of Alaska, in whole or in part, would be removed from the jurisdiction of the United States Department of Agriculture.

A Resolution bearing on the Introduction of Non-native Plants and Animals into the National Parks of the United States.

WHEREAS, One of the primary duties of the National Park Service is to pass on to future generations for scientific study and education, natural areas on which the native flora and fauna may be found undisturbed by outside agencies; and

WHEREAS, The planting of non-native trees, shrubs or other plants, the stocking of waters with non-native fish, or the liberating of game animals not native to the region, impairs or destroys the natural conditions and native wilderness of the parks;

BE IT RESOLVED, That the American Association for the Advancement of Science strongly opposes the introduction of non-native plants and animals into the national parks and all other unessential interference with natural conditions, and urges the National Park Service to prohibit all such introductions and interference.

A Resolution bearing on Scientific Journals published by the Government of the United States.

WHEREAS, Scientific research and its applications to the public welfare are essential to the nation, as is recognized by our government in its support of scientific work; and

WHEREAS, The publication of scientific work is a necessary part of the work itself to make it of use to agriculture, manufactures and the life of the nation, as has long been recognized by the government in the publication of scientific journals, bulletins and reports;

THEREFORE BE IT RESOLVED, That the American Association for the Advancement of Science, whose members include more than 10,000 of those most actively concerned with scientific work, urgently request that the Congress of the United States take steps to assure the resumption of the publication of journals devoted to research, such as *The Journal of Agricultural Research*, *The Experiment Station Record* and *The Monthly Weather Review*.

A Resolution on the Question of an International Auxiliary Language.

WHEREAS, All the sciences are alike interested in unifying the fundamental tools of thought, and have been notably successful in so doing, with respect to our system of numbers, the Arabic

numerals, the metric system, the measurement of latitude and longitude, angular divisions, mathematical symbols, chemical formulæ, time and the calendar, notation in music, and other technical usages; and

WHEREAS, There appears to be a generally expressed need for a suitable international auxiliary language for the prompt and world-wide diffusion of scientific data, and for intercommunicating between nations differing in languages;

THEREFORE, BE IT RESOLVED, That the American Association for the Advancement of Science:

(*a*) Recognizes the need and timeliness of fundamental research on the scientific principles which must underlie the formation, standardization, and introduction of an international auxiliary language, and recommends to its members and affiliated societies that they give serious consideration to the general aspects of this problem, as well as direct technical study and help in their own special fields wherever possible;

(*b*) Looks with approval upon the attempt now being made by the National Research Council and the American Council of Learned Societies to focus upon this subject the effort of those scholars in this country best fitted for the task, and to transmit the results to the appropriate international bodies;

(*c*) Indorses the heretofore relatively neglected problem of an international auxiliary language as one deserving of support and encouragement;

(*d*) Continues its Committee on International Auxiliary Language, charging it with the furtherance of the objects above enumerated and reporting progress made to the association at its next meeting.

A Resolution bearing on the Introduction of the Metric System in the United States.

WHEREAS, The metric system of weights and measures has been favorably endorsed by many societies and organizations affiliated with the A. A. A. S.;

WHEREAS, The A. A. A. S. has by resolution of its governing Council already affirmed its belief in the desirability of adopting the metric system by the United States; and

WHEREAS, Legislative bills aiming to bring about the adoption of the metric system have been introduced in Congress;

THEREFORE, BE IT RESOLVED, That the A. A. A. S. urges on Congress the passage of legislation which will go farther than the present legislation (which permits the use of the metric system) and will require the use of the metric system in such branches of trade and commerce as are subject to general direction and regulation by the government of the United States.

A Resolution bearing on the Appointment of the U. S. Commissioner of Fisheries.

WHEREAS, The United States Commissioner of Fisheries has presented his resignation; and

WHEREAS, The position is one demanding, for the proper discharge of its duties, technical knowledge of the scientific work of the fisheries and their utilization for the benefit of the nation, as well as administrative skill and experience;

THEREFORE, BE IT RESOLVED, That the Council of the American Association for the Advancement of Science desires to emphasize, in connection with the selection of a new commissioner, the prime importance of securing a man who possesses both the special experience and scientific knowledge of the field, combined with the necessary administrative ability for discharging the duties of the position; and

BE IT FURTHER RESOLVED, That copies of this resolution be sent to the President of the United States and to the Secretary of Commerce.

RESEARCH IN THE FIELD OF AGRICULTURE

THE one big agricultural lesson which the War has driven home is a realization of the definite relation between the world's increasing population and the amount of food material of all kinds which it is possible to make the civilized and war-free portions of the world produce. Never before have we realized so clearly as now that the population of the world is crowding closely upon its present limits of food production and that some countries in fact for a long time have fallen far short of their needs in their own production of food. In spite of all the recent development in aerial navigation, wireless communication, manufacturing, and extension of transportation facilities and of trade, agricultural productivity, just as much as ever, remains the foundation of our well being. And the significance of all this is that agriculture must be made increasingly intelligent and must lay hold of all that science can offer to meet the ever increasing demand not only for food but for better foods.

There is a broadening opportunity, then,

for investigation of agricultural problems and for applying our best knowledge of the principles of chemistry, engineering, biology, sociology, and economics to the production, distribution, and consumption of food and of the raw materials of manufacture. The man who by reason of his intelligence can take advantage of our knowledge not only to make two ears of corn grow where only one grew before, but to make those two ears higher in their nutritive value or to convert a higher percentage of their food value into ultimate human energy through the mechanism of a steer, a pig, or a grist mill and bakery, will make his mark and will render a service to humanity in which he can take solid satisfaction. There are scores of careers open in connection with the many, many unsolved or partially solved agricultural problems for young men and young women who have the brains and educational equipment to tackle them. Research in agriculture not only adds to the sum of human knowledge; it adds to the amount we may have to eat, to the comfort of the clothes on our backs, to the cheapness of all these necessities, and to the amount of money we may all have for the enjoyment of the other things of life.

Our knowledge of the physics and chemistry and biology of the soil, for instance, needs re-study in the light of the modern development of these sciences and the perfection of instruments and methods in these fields of research. These newer methods must be applied to the study of fertilizers and their action, and to plant and animal nutrition. The fat soluble A's and the water soluble B's must yield their secrets. The problems of disease resistance and immunity must be reinvestigated by the newer methods now available. We must perfect instruments and methods for the study of the ultra-microscopic organisms and disease producing agencies as the physicists have done in the study of the atom and electron. We do not yet know the causative agent of the mosaic diseases which are becoming more destructive to many of our important crops each year. Peach yellows is almost as great a mystery as it was in the beginning. We do not know the causative agent of hog cholera and a number of other destructive diseases of live stock. The newer chemistry and physics applied to the study of plant and animal physiology are opening a new chapter in those fields. Many obscure problems in storing and transportation of perishable fruits and vegetables are yielding to these newer methods of study.

Plant and animal diseases reduce our food producing efficiency fully 20 per cent. per annum on the average. Our understanding of them and the methods of controlling them is still very imperfect. The whole field needs reworking by men trained in the newer methods and in the light of our modern knowledge. The idea of the fixity of species and their special creation has only recently been laid to rest. We are just entering the field of genetics and plant and animal breeding. What has been accomplished so far has depended upon chance variation and selection. We are only just beginning to unravel the laws governing variation and heredity. What powers the greater and more exact knowledge may give us we can only dimly conjecture now. The new physics, chemistry, and biology are yet in their infancy. They are our keys to greater knowledge. Our modernly trained scientist who is to devote himself to the building up of the new agricultural science must have these keys at his command. He must prepare himself with the same thoroughness that the modern chemist or physicist prepares for his work. He will need also to learn the art and necessity of cooperation. One mind cannot compass the whole field. The advance of the future will be made largely by closely cooperating groups of chemists, physicists, biologists, pathologists, etc. The colleges and universities must study and promote every phase of this great problem. They must find the leaders and the promising students and provide them with all they need for their work. The field is an attractive one for those who desire to render great service and who love the joy of discovering truth. The scientists, the inventors, the teachers, the poets, and the writers devote their energies to these fields for the love of the work and the joy that acknowledged accomplishment brings. It

is something that money cannot buy. The financial reward is seldom thought of. Nevertheless it is coming to be an important accompaniment.

The universities and colleges are being heavily drawn upon by commerce and industry for trained thinkers and investigators. Great private foundations must go to the universities for trained men. Governmental agencies, state and national, can not find enough trained students to meet their needs. The experiment stations and the national Department of Agriculture are constantly in need of more and better trained personnel. While salaries offered by government and state agencies are usually not as large as those paid in the industrial world there are other compensations. There is a strong and increasing demand for men trained in the various branches of agricultural science. Work of this kind in foreign fields is very attractive to many. The state universities and agricultural colleges are awake to the new needs. They are organizing their research with the cooperation and backing of the national and state governments, with a view to encouraging the promising investigator and student and to maintaining the vivifying atmosphere that the research spirit and accomplishment gives to the university. Thorough preparation not too specialized in the first two or three years is essential to future success. The basic sciences, mathematics, physics, chemistry, and biology, together with a knowledge of modern languages must be stressed with the specialized work in the selected field.

In the graduate schools the development in the next few years will doubtless be along the line of developing special research facilities in particular fields. It should be possible to find there the men, the books, the laboratories, and the equipment necessary for the most effective investigation in the particular fields stressed. This would bring about a greater interchange of students which would be good for the university as well as the student. There never has been a time when the need for agricultural research of the first order was as necessary as it is today. The growing recognition of this need and appreciation for the service that may be rendered promises well for the future. The call for prepared and devoted workers should be heeded by the best young men and women of our colleges.

A. F. Woods
University of Maryland

SCIENTIFIC EVENTS

INVESTIGATION OF CARBON MONOXIDE POISONING

In order to make accurate observations for determining and treating carbon monoxide poisoning among those employed in mines, metallurgical plants, and tunnels, a number of investigations are being conducted at the Pittsburgh Experiment Station of the United States Bureau of Mines.

Methods of collecting and preserving blood from persons affected or overcome by carbon monoxide have been investigated and developed. Blood samples were collected in various parts of the United States, forwarded to Pittsburgh, and there examined. A preliminary report has been submitted.

The following methods of analysis of blood in the presence of carbon monoxide have been studied by Bureau of Mines investigators: Haldane's picrocarmin method, tannic acid method, spectrophotometric method, and the Van Slyke gasometric method. The Haldane picrocarmin method proved to be the least desirable, being very inaccurate with low concentrations; the tannic acid method was accurate but tedious; the spectrophotometric method was accurate and rapid, but required expensive apparatus; the Van Slyke method was the most dependable, but it required a comparatively large sample, 2 to 4 c. c., for each determination. A report on these methods of analysis has been submitted.

A study of the feasibility of using in first-aid work a mixture of carbon dioxide and oxygen, first recommended by Dr. Yandell Henderson, for resuscitation of persons overcome by carbon monoxide was conducted on both dogs and men. Results indicated that in its present state of development the method is not feasible for use by first-aid men.

In the conduct of the above investigations a superior method for the selection of analysts for color work in chemistry was developed,

which it is believed can be applied to advantage in any laboratory requiring careful colorimetric determinations. Also the solubility of carbon monoxide in serum and plasma was determined, the amount of carbon monoxide dissolved in the serum proving to have little effect upon the accuracy of colorimetric determinations. The figures for the solubility of carbon monoxide in serum have also a purely scientific value in the calculation of carbon dioxide in serum and the determination of the hydrogen in concentration.

In addition to these studies on carbon monoxide Dr. Yandell Henderson and Dr. W. Haggard, as consulting physiologists to the Bureau of Mines, in work done at the Laboratory of Applied Physiology at New Haven, Conn., on the problem of the elimination of carbon monoxide from the blood after a dangerous degree of asphyxia, have determined that ventilation of the lungs could be increased from 300 to 400 per cent. by adding 6 to 10 per cent. of carbon dioxide to pure oxygen. These investigators have also shown that the effects of carbon monoxide upon the heart are not specific, but are secondary to general asphyxia and a terminal failure of respiration. Material is now available for a report showing that symptoms and effects sometimes assigned to chronic carbon monoxide poisoning are in reality due to the effects of benzol and related substances in illuminating gas. This conclusion has a direct bearing on the use of mixtures of gasoline and coal distillate in underground locomotives.

WORLD LIST OF SCIENTIFIC PERIODICALS[1]

THE Conjoint Board of Scientific Societies proposes, if sufficient support is obtained, to arrange for the issue of a world list of periodical publications which contain the results of original scientific research, and has entrusted preliminary arrangements to a committee, of which the following are members: Sir Sidney F. Harmer (chairman), Mr. F. W. Clifford, Sir Richard Gregory, Dr. P. Chalmers Mitchell, Mr. A. W. Pollard, and Professor W. W. Watts, secretary.

The list will be an octavo volume containing, in alphabetical order, the titles and places of publication of all such periodicals in existence on January 1, 1900, and of all issued after that date.

Libraries in London, Oxford, Cambridge, Edinburgh, Dublin and Aberystwyth which take in these periodicals will be indicated in the list, and, wherever possible, at least one library in the United Kingdom will be indicated for each title.

The copies will be printed on one side only to facilitate alterations and additions.

The objects of the proposed volume are: (1) To supply as nearly as possible a complete list of current scientific periodicals; (2) to indicate, where possible, at least one library where each periodical is taken; (3) to form a basis for cooperation between libraries, so that both the number of duplicates and the list of periodicals not taken in may be reduced; and (4) to enable each library to use the list for its own purposes, by placing a mark against the title of each periodical it possesses, by cutting up for a card index, etc.

The trustees of the British Museum, recognizing the importance of this work to scientific research and bibliography, have consented to allow the compilation to be undertaken by the staff of the Museum. They are unable, however, to defray the cost of printing and publication.

Although the value of a list of this kind to libraries and scientific societies would be very great, it is scarcely possible that the production of so costly a work would be entertained by a publishing firm as an ordinary commercial enterprise. If, however, a sufficient number of libraries and institutions agree in advance to purchase one or more copies, when issued, the compilation of the list will be put in hand at once. Already a large bulk of material has been collected in the British Museum by various societies and by the Conjoint Board.

I shall be glad to receive by January 31, if possible, the names and addresses of institutions or individuals who will support this proposal by undertaking to subscribe for one or more copies of the list. The price per copy will be 2*l.* 2*s.* net.

W. W. WATTS
CONJOINT BOARD OF SCIENTIFIC SOCIETIES,
BURLINGTON HOUSE, LONDON, W. 1

[1] From *Nature*.

EMILE CARTAILHAC AND OSCAR MONTELIUS

PROFESSOR EMILE CARTAILHAC, of the University of Toulouse, died suddenly on November 25 last, at the age of seventy-six. Professor Cartailhac, besides being a teacher, was a museum curator, and of late years served also as official guide to the local caverns of archæological interest, but he nevertheless found time for extensive field research and publication. As dean of the French prehistorians, he was instrumental not only in giving tremendous impetus to scientific archæology but also in training several of the younger men that still remain to carry on the work.

OSCAR MONTELIUS, former antiquary to the Realm of Sweden, succumbed to pneumonia in Stockholm, on November 4, at the age of seventy-eight. His death marks the close of a most distinguished career, for although primarily in charge of the Swedish archæological collections in the National Museum at Stockholm and thoroughly in love with his task, Professor Montelius concerned himself quite as much with the prehistory of the rest of Europe, as well as of the adjacent portions of Asia and Africa. In many respects his work was complementary to that of the late Gustav Retzius and his writings are characterized by the same breadth and profundity. Montelius did more than any one else toward placing the chronology of the Neolithic and Metal ages on a sound basis. His death, coming so nearly at the same time as that of Professor Emile Cartailhac of France, is a distinct loss to all students of prehistoric archæology.

N. C. NELSON

OFFICERS OF THE BRITISH ASSOCIATION

THE following, as we learn from *Nature*, have been appointed presidents and recorders (to whom all communications should be sent) of the different sections of the British Association for the meeting to be held at Hull on September 6-13 next under the presidency of Professor C. S. Sherrington: *Section A* (*Mathematics and Physics*): President, Professor G. H. Hardy; Recorder, Professor A. O. Rankine, Imperial College of Science and Technology, S. W. 7. *Section B* (*Chemistry*): President, Principal J. C. Irvine; Recorder, Professor C. H. Desch, University of Sheffield. *Section C* (*Geology*): President, Professor P. F. Kendall; Recorder, Dr. A. R. Dwerryhouse, University College, Reading. *Section D* (*Zoology*): President, Dr. E. J. Allen; Recorder, Mr. R. D. Laurie, University College, Aberystwyth. *Section E* (*Geography*): President, Dr. Marion I. Newbigin; Recorder, Dr. R. N. Rudmose Brown, University of Sheffield. *Section F* (*Economics*): President, Professor F. Y. Edgeworth; Recorder, Professor H. M. Hallsworth, Armstrong College, Newcastle-upon-Tyne. *Section G* (*Engineering*): President, Professor T. Hudson Beare; Recorder, Professor G. W. O. Howe, Elmswood, Malden, Surrey. *Section H* (*Anthropology*): President, Mr. H. J. E. Peake; Recorder, Mr. E. N. Fallaize, Vinchelez, Chase Court Gardens, Enfield, Middlesex. *Section I* (*Physiology*): President, Professor E. P. Cathcart; Recorder, Dr. C. Lovatt Evans, National Institute for Medical Research, Mount Vernon, N. W. 3. *Section J* (*Psychology*): President, Dr. W. H. R. Rivers; Recorder, Dr. C. Burt, 30 Princess Road, Regent's Park, N. W. 1. *Section K* (*Botany*): President, Professor H. H. Dixon; Recorder, Mr. F. T. Brooks, 31 Tenison Avenue, Cambridge. *Section L* (*Education*): President, Sir Richard Gregory; Recorder, Mr. D. Berridge, 1 College Grounds, Malvern. *Section M* (*Agriculture*): President, The Right Hon. Lord Bledisloe; Recorder, Mr. C. G. T. Morison, School of Rural Economy, Oxford.

OFFICERS OF THE AMERICAN ASSOCIATION

AT the Toronto meeting of the council of the American Association for the Advancement of Science there were elected, besides the officers whose names were published in SCIENCE for January 6, the following:

Chairman of Section D: Otto Klotz, director of the Dominion Observatory, Ottawa.

Secretary of Section K: Frederick L. Hoffman (to retire at the end of 1924), Prudential Life Insurance Company of America, Newark, N. J.

Secretary of Section N for 1922: A. J. Goldfarb, College of the City of New York, New York, N. Y.

Members of the Council: J. McKeen Cattell (to retire at the end of 1924), Garrison-on-Hudson, N. Y.; F. G. Cottrell (to retire at the end of 1924), National Research Council, Washington, D. C.; Henry C. Cowles (to retire at the end of 1925), the University of Chicago, and John C. Merriam (to retire at the end of 1925), the Carnegie Institution of Washington.

Members of the Executive Committee: Simon Flexner and W. J. Humphreys were elected to succeed themselves, as members of the executive committee (to retire at the end of 1925).

The following were appointed to membership in the Committee on Grants, to succeed Henry Crew, Joel Stebbins and G. H. Parker, who retired at the end of 1921: E. G. Conklin (to retire at the end of 1925), Princeton University, E. L. Nichols (to retire at the end of 1925), Cornell University), and F. R. Moulton (to retire at the end of 1922), the University of Chicago.

SCIENTIFIC NOTES AND NEWS

DR. EDGAR F. SMITH, provost emeritus of the University of Pennsylvania, has been elected an honorary member of the Chemical, Metallurgical and Mining Society of South Africa.

CHARLES W. GOODALE has been awarded the gold medal of the Mining and Metallurgical Society of America for distinguished service in increasing the safety of men in mining and metallurgical operations.

DR. F. G. COTTRELL, of the National Research Council, has been elected an honorary member of the French Society of Chemical Industry.

THE American Society of Agricultural Engineers has elected A. J. R. Curtiss, of Chicago, president for the coming year.

ACCORDING to the *Journal* of the Washington Academy of Sciences, the following Washington scientific men have been appointed members of the technical staff of the American delegation to the Conference on the Limitation of Armament: Dr. L. W. Austin, radio specialist of the Navy Department; Dr. J. H. Dellinger, chief of radio investigations at the Bureau of Standards; Gen. Amos E. Fries, chief of the Chemical Warfare Service of the Army; Gen. George O. Squier, chief of the Signal Corps of the Army; and Dr. S. W. Stratton, director of the Bureau of Standards.

AT the recent meeting of the American Association of Anatomists in New Haven, the following officers were elected: *President,* Clarence M. Jackson, University of Minnesota; *Vice-President,* Harold D. Senior, New York University; *Secretary-Treasurer,* Lewis H. Weed, Johns Hopkins University; *Members of the Executive Committee:* Davenport Hooker, University of Pittsburgh, and Benjamin F. Kingsbury, Cornell University.

CELEBRATIONS were held at Liége on December 4, in honor of the completion of fifty years of scientific work of Professor Leon Frédéricq. A bas-relief portrait of himself in bronze was presented to him, and this will be placed later in the Institute of Physiology at Liége. Representatives of the Universities of Lausanne and of Strasbourg conferred honorary degrees upon Professor Frédéricq.

A DUTCH pharmacist, Dr. H. Baljet, of Arnheim, has been awarded the Davy prize by the University of Geneva for an essay on the dosage of digitalis.

THE docent of neurology at the Karolinska Mediko-Kirurgiska Institut at Stockholm, Dr. N. Antoni, has been awarded the Lennmalm prize for 1921 by the Swedish Medical Association.

S. J. SPEAK has been elected president of the Institution of Mining and Metallurgy, London.

DR. ROBERT N. NYE, formerly research assistant to Dr. F. B. Mallory, has accepted the position of assistant director of the division of biologic laboratories of the Massachusetts State Department of Public Health.

DR. WILLIAM A. PERLZWEIG has resigned the position of biochemist in the New York branch of the Hygienic Laboratory and has accepted an appointment as chemist to the Medical Clinic of the Johns Hopkins University.

A MEDICAL scholarship for women is to be established in the University of California in memory of Dr. Sarah Sluey of the class of 1876. Dr. Sluey was the first woman who graduated in medicine from the university.

T. M. JASPER, assistant professor of mechanics at the University of Wisconsin, has been placed in charge of tests in the joint investigation of the fatigue of metals, being carried on at the Engineering Experiment Station of the University of Illinois, in conjunction with the National Research Council and the Engineering Foundation.

MR. PHILIP L. GILE, formerly connected with the American Agricultural Chemical Company, in their agricultural service bureau, and for eleven years prior to that position chemist of the Porto Rico Agricultural Experiment Station, is at present in charge of the division of soil chemical investigations of the Bureau of Soils, U. S. Department of Agriculture, Washington, D. C.

AT the annual general meeting of the Harveian Society, held in London on January 12, Dr. G. de Bec Turtle delivered the presidential address on "Some Points on Spasm in the Alimentary Tract."

ALFRED H. BROOKS, of the United States Geological Survey, retiring president of the Washington Academy of Sciences, delivered an address on "The Scientist in the Federal Service" at the annual meeting held at the Carnegie Institution on January 10.

WARREN T. CLARKE, professor of agricultural extension of the University of California, has been invited as a guest of the Pacific Mail Steamship Company to study the control of ants on shipboard. He sailed on December 12 on the *Columbia* which makes Mexican and Central American ports passing through the Canal and proceeding by way of Havana to Baltimore.

THE American Society for Testing Materials and the United States Forest Service have been designated by the American Engineering Standards Committee as joint sponsors for the development of uniform standard methods of testing wood. This action was taken as the result of a canvass made of the principal national bodies concerned with the proposed project, from which it was apparent that there is a real demand for the work, and that the joint sponsorship here indicated would be acceptable to the industry.

A CONFERENCE under the auspices of the National Research Council in Washington was held on December 23 to consider the problem of the university and college student of superior attainment. The conference was attended by Frank Aydelotte, president of Swarthmore College; S. P. Capen, director of the American Council on Education; J. Crosby Chapman, associate professor of educational psychology, Yale University; John J. Coss, assistant professor of philosophy, Columbia University; Louis T. More, professor of physics, University of Cincinnati; A. A. Potter, dean of the schools of engineering, Purdue University; J. J. Tigert, United States commissioner of education; Ernest H. Wilkins, professor of romance languages, University of Chicago; C. E. Seashore, professor of psychology, University of Iowa, and chairman of the Division of Anthropology and Psychology, National Research Council, and A. L. Barrows, assistant secretary of the National Research Council. Dr. Vernon Kellogg, permanent secretary of the council and chairman of the Division of Educational Relations, presided. General discussions, specially introduced by various members of the conference, were had of such subjects as honors courses, fellowships, special privileges, sectioning of classes, analyzed ratings, etc. Various suggestions were made of work which might be done to stimulate interest in and active attention to the problem by university and college faculties, and a resolution was passed urging the National Research Council to continue and extend work along the line already undertaken by it.

THE *London Times* announces that the council of the Royal Horticultural Society has become responsible for continuing the publication of Curtis's *Botanical Magazine*. During the war the number of subscribers fell and,

when Messrs. Lovell Reeve & Co., who had bought the magazine from the Curtis family in 1845, found themselves unable to continue the publication, they offered the copyright to Kew for £250. Although the botanical authorities would gladly have carried on the publication, the government refused to sanction the purchase, and at one time there was considerable anxiety lest the copyright should be sold and cross the Atlantic. At a dinner of some leading horticulturists on the first night of the Chelsea Show the feeling was so strong that the magazine must remain in England that the requisite sum was guaranteed at once and the copyright was purchased on the following day. The next step was to propose to allow the magazine to appear as an official publication from Kew; but the Treasury refused to sanction the conditions imposed by the new owners. The latter then approached the council of the Royal Horticultural Society, with the result that it is hoped to resume publication in 1922, and an early announcement will be made as soon as the negotiations and arrangements are complete.

THE Elgin Observatory of the Elgin National Watch Company, at Elgin, Illinois, on Armistice Day, November 11, 1921, obtained its first chronographic record of the French scientific radio time signals from the LaFayette Station, Bordeaux, France, at a distance of 4,400 miles. The recording apparatus devised by Frank D. Urie is entirely automatic, the incoming radial signals controlling the movement of the chronographic pen. The receiving aerial is a small one consisting of a single wire 180 feet long and 30 feet high.

WE learn from the *Journal* of the American Medical Association that a bill has been introduced in the Senate and House of Representatives to "reorganize and promote the efficiency of the United States Public Health Service." It is known as the Watson-Dyer bill. The bill provides for 550 officers of the reserve corps of the Public Health Service, including 50 dental surgeons and 50 scientists other than medical officers, who may be transferred to and commissioned in the regular corps of commissioned officers of the Public Health Service by the President, in the grades of assistant surgeon, passed assistant surgeon, surgeon, senior surgeon, and assistant surgeon-general. Officers in the last grade will be known as medical directors. No officer will be commissioned or promoted until after passing an examination before a board of regular commissioned officers of the Public Health Service. The bill further provides that no reserve officer shall be commissioned in the regular corps of the Public Health Service who has not had three years' satisfactory service in the army, navy or Public Health Service, a part of which service must have been between April 6, 1917, and November 11, 1918. There are only 200 regular commissioned officers in the Public Health Service at present. They are largely engaged in administration, scientific research, industrial and child hygiene, neuropsychiatry, domestic and foreign quarantine, immigration, prevention of venereal diseases, public health education, and other matters pertaining to public health. There are about one thousand commissioned officers of the reserve of the Public Health Service on active duty, caring for ex-service men. These officers are indispensable, yet they have no fixed tenure of appointment. The Watson-Dyer bill transfers at least half of them to the regular service without any additional expense.

UNIVERSITY AND EDUCATIONAL NOTES

MR. GEORGE F. BAKER, chairman of the board of directors of the First National Bank, has given $700,000 to Columbia University for the purchase of an athletic field on Dyckman Street. The property, which comprises twenty-six acres, will be developed at a cost of about $3,000,000.

THE University of North Carolina has received the sum of $26,000 for the establishment of the Graham Kenan fellowship in philosophy. The gift was made by Mrs. Graham Kenan in memory of her late husband.

PROFESSOR WM. R. WORK, of the Carnegie Institute of Technology, has been placed in charge of the department of electrical engineer-

ing, to succeed Professor Alexander J. Wurtz, who has been made research professor in the new research division of the institute.

DR. J. A. GUNTON has been appointed head of the chemistry department in Transylvania College, Lexington, Ky. Dr. Gunton recently received his doctorate of philosophy from the University of Illinois.

DR. CLIFFORD S. LEONARD, for the past year fellow in chemistry to Sweden on the American-Scandinavian Foundation, has completed his research at the Karoline and Nobel Institutes of Stockholm and has been appointed research instructor of pharmacology at the University of Wisconsin.

DR. R. H. ADERS PLIMMER has been appointed by the Senate of London University to the university chair of chemistry, tenable at St. Thomas's Hospital Medical School, beginning with the new year. At present he is head of the biochemical department of the Rowett Research Institute at the University of Aberdeen.

DISCUSSION AND CORRESPONDENCE

SEARCH FOR THE RECORD OF ROBERT HANHAM COLLYER, M. D.

DR. COLLYER was registered as practicing medicine in London as late as the year 1878. After this it is believed he returned to America. Long previous to this, namely, in 1867, he had announced in the *Anthropological Review* a very important discovery,—a prehistoric jaw-bone of great geologic age. Of this Mr. J. Reid Moir of Ipswich, England, writes:

I am of the opinion that if the Foxhall jaw-bone could be reexamined now, it would be possible to say with considerable certainty as to whether it was derived from the Crag, or not. But, unfortunately, the specimen cannot now be found, and advertisements placed by me in various newspapers and other journals have failed to bring it to light. Owing to the kindness of the acting registrar to the General Council of Medical Education and Registration of the United Kingdom, I have been informed that Dr. Robert Hanham Collyer was registered in England on the 23rd of June, 1868, with the qualification M.D., Medical College, Pittsfield, Massachusetts, 1839. His application for registration is dated the 23rd of October, 1867, when he gave his address as 40, Carlton Hill, St. John's Wood. At the time of his registration he was at 1, Norman Terrace, Stockwell, which he subsequently changed to 199, Brompton Road, S. W., which was his registered address in 1878, in which year his name lapsed from the Medical Register in consequence of this address having been found to be inaccurate by means of an inquiry under Section 14 of the Medical Act. According to the American Medical Directory, the college from which, apparently, he obtained his degree is described as the Berkshire Medical College, Pittsfield, Massachusetts, an institution which is classed with those which are extinct—or merged with other colleges. There is reason to believe that Collyer returned eventually to America, taking the Foxhall jaw-bone with him. It would seem unlikely—in view of the importance he attached to the specimen—that no instructions would be left by him for the preservation of the specimen after his death, and I hope that the publicity now given to this matter may result in the Foxhall jaw-bone being once more brought to light.

There are several clues to aid our search. First the records and graduates of the Pittsfield Medical College. Some member of Dr. Collyer's class may have left descendants. Or, some member of his family may recall him. Or, the Philadelphia Academy of Natural Sciences may find letters from Dr. Collyer to Dr. Samuel G. Morton, the distinguished anthropologist of that institution.

HENRY FAIRFIELD OSBORN
AMERICAN MUSEUM OF
NATURAL HISTORY,
NEW YORK CITY

THE PROTECTION OF MICROSCOPIC SECTIONS

REFERRING to Professor Long's suggested method for protecting microscopic sections from mechanical injury in SCIENCE of October 7th., may I suggest the following, which will remedy the difficulty without resorting to the use of a thin film of parlodion.

Instead of using the *natural* Canada balsam for mounting (which does remain fluid for years), use balsam prepared by heating the

natural product on a water bath until it is hard, but not brittle, when cool. Then dissolve in a menstruum such as chloroform or xylol. After balsam is applied to the slide allow to stand over-night and then finish by placing cover glass over the sections, using gentle heat to render the balsam fluid. This mounting medium will then be found to be hard enough to withstand any pressure applied on the cover glass by careless students.

It is advisable to prepare this balsam oneself, unless it can be procured from a reliable firm which uses the above method of preparation.

GEORGE H. NEEDHAM
COLLEGE OF PHARMACY,
UNIVERSITY OF WASHINGTON,
SEATTLE, WASH.

THE HISTORY OF SCIENCE

RELATIVE to your recent articles on the history of science and its present position in American colleges, you might be interested to know that efforts are being made to adapt the history of science as a cultural course for engineering students. I taught such a course in the college of engineering of the University of Colorado, and now am teaching it in the college of engineering of New York University.

PHILIP B. MCDONALD
DECEMBER 27, 1921.

AMEBOID BODIES ASSOCIATED WITH HIPPEASTRUM MOSAIC

IN a recent publication [1] the writer described and pictured certain bodies in the cells of corn plants suffering from mosaic disease. Since the bodies are confined to diseased portions of the plant, it was suggested that they might be of etiological significance.

Those who are working on the mosaic disease problem will be interested to know that similar bodies have now been found in the light green portions of mosaic leaves of *Hippeástrum equéstre* Herb. This plant belongs in the Amaryllidaceae and is not closely related to corn. Its leaves which are thick and soft are well suited for cytological studies. The mosaic pattern shown by *Hippeástrum* is quite different from that of corn. The intracellular bodies associated with this disease will be described in detail in a future paper.

[1] Bul. Exp. Sta. H. S. P. A. 3:44-58 (1921)

L. O. KUNKEL
EXPERIMENT STATION OF THE HAWAIIAN SUGAR PLANTERS' ASSOCIATION,
HONOLULU, T. H.

THE TUNING FORK

IN SCIENCE for November 11, I cited briefly some inadequate references to the actions of a tuning fork to justify the preservation of matter that was very old; there was no reason to name the writers for these references were minor parts of their papers. But in SCIENCE for December 16, one of the writers, Mr. Young, comes to the front, as if I had made a personal attack on him, and defends his former expressions, but qualifies them, still leaving the subject in a very confused state. He quotes his former dynamically unsound "statement that the fork has only a single note at the base" and now adds the indefinite remark, "This of course is only an approximation"; it is noteworthy that he does not attempt to state what he thinks is the truth.

In his final paragraph he attributes to Professor Watson an "alternative explanation" which is only a corollary of Chladnis' old accepted theory; but probably the professor of physics would not use over his own signature such an inexact expression as the "center of mass tends to rise" or "lower," or leave it doubtful whether "center of mass" always relates to the same point.

CHARLES K. WEAD

QUOTATIONS

"KEY" CHEMICALS

LORD CREWE and Lord Haldane argued last week for the release of scientific apparatus and chemicals from the restrictions imposed by the safeguarding of industries act and the reparation act. Scientific research and the teaching of scientific students, they alleged, were seriously impeded because of the delay and difficulty in importing certain chemicals and apparatus from Germany. The stronger

the evidence for their case, the more certainly does it lead away from the action they pressed on the government. Although protection may be dubious as a general principle, there are certain industries of little intrinsic economic importance, and yet vital to the national safety, because of the dependence of larger industries upon them. Are there any avocations more certainly "keys" to national prosperity than scientific research and the training of scientific workers? In these matters we must depend neither on Germany nor on any foreign country. If dependence exist at present, the administration of the acts should be tightened, not relaxed, until we become self-supporting. But the case is probably over-stated. Before the war scientific workers here and in the United States had got in the habit of using such chemicals as bacteriological stains and such forms of optical glass as microscopic lenses from one or two German makers, not because these were better than all others, but because they were standardized and all workers using them could easily compare their results. Convenience, not necessity, had led to a German monopoly. American bacteriologists are endeavoring to meet the state of affairs by agreeing on a reliable standard brand of each kind of stain and discouraging the use of variants. Similar action might be taken in this country not only with regard to stains, but to many other kinds of chemicals and of apparatus used in research. But we note with concern as further witness of the aloofness of the state from science, that the interpellations on this scientific question were addressed to the minister of transport, who undertook, apparently to the satisfaction of every one, to refer it to the president of the Board of Education. Is there not a Royal Society, at one time the natural adviser of the government on scientific matters?—*The London Times.*

SCIENTIFIC BOOKS

Studies on some Flagellates. E. Penard. Proc. Acad. Nat. Sci. Phila., 1921, Part 1, Oct. 12. Idem, Etudes sur les Infusoires d'eau douce; Geneva, "1922" [1921].

The inadequacy of our knowledge of local protozoan faunas is emphasized by two recent papers by the veteran Swiss protozoologist, Penard, in which he describes, chiefly from two limited regions in the environs of Geneva, 7 new Flagellates and 148 new species of Ciliates, including 8 new genera. Central Europe has been more intensively studied faunistically than any other portion of the world, yet six years observation by one student has brought to light 155 new forms in groups which are the especial delight of the microscopist and which have been by no means neglected by the protozoologist. Faunistic data furnish material essential to the study of many far-reaching problems in ecology, in distribution, in geology, and especially in paleogeography. Yet it is evident, from such papers as Penard's, that our faunistic data for all regions are only fragmentary.

Many of Penard's papers, like those of Leidy, show an intimate and friendly companionship with these microscopic forms, being full of data as to behavior, structure and function being described together, conveying to the reader a vivid impression of the lives of these organisms and showing an interest on the part of the observer which is contagious. May it not be that laboratory zoology is to-day disproportionately emphasized in comparison with out of door studies? A broad knowledge of field natural history, combining taxonomic, faunistic and ecological studies and studies of behavior under natural environmental conditions, is essential to any adequate attack upon many problems, among which are some of the most interesting in the whole field of zoology. This is a type of work to which it is easy to introduce young students and it is one to which a fair proportion of them could well afford to devote their lives, for evidently our knowledge in this field is most inadequate. The field, while easy to enter, calls for the finest qualities of skill, accuracy, persistence and judgment. It commands a natural interest and it gives data of wide bearing.

Maynard M. Metcalf
The Orchard Laboratory
Oberlin, Ohio

SPECIAL ARTICLES

THE FORMS OF GAS AND LIQUID CAVITIES IN GELS, AND THEIR INTERPRETATION BY SURFACE COMPRESSION

IT has been observed by both chemists and biologists that gas bubbles arising in gels exhibit lenticular forms. The most complete investigation of the phenomenon has been made by Hatschek who, after making measurement on many bubbles, endeavored by a statistical study of their orientations to explain the observed facts, including the divergence from sphericity, by postulating definitely oriented directions of cleavage within the gel, corresponding presumably to a honeycomb microstructure of its water-poor phase. Neither Hatschek himself nor later workers have been convinced that this explanation was the true one. Working with gelatine, but more especially with silica gels, the writers have produced, from air-saturated media, controllable airbubbles both by rise of temperature and by reduction of air pressure, and have observed additional facts that lead to an altogether different, albeit simple and complete, interpretation of everything observed.

Concomitantly as the gas content of a bubble is caused progressively to diminish, the space formerly occupied by the gas becomes filled by infiltration with liquid from the liquid phase of the gel, giving rise finally to liquid-filled, phantomlike, cavities, whose very existence has heretofore escaped observation. The forms of these cavities thus arising spontaneously in an isotropic medium on alteration of a single external condition are exceedingly symmetrical and beautiful. As demonstrated by photomicrographs, they exhibit two main types:

(1) If derived from gas cavities of oblate spheroidal form, the liquid-filled phantoms are of forms that may be likened to bivalve molluscs whose shells are either (a) segments of spheres, or bowl-shaped; or (b) of inflected curvature, like a circular basin with a flaring edge; or (c) like the last, but with a central apical spike like that of a helmet. Each one of these forms is immediately explicable if it be considered that, while forming, the original airbubble thrust aside the elastic water-poor phase of the gel, which was thus obliged to collect in an elastic layer or membrane under compression round the periphery of the bubble. The bubble cavity is thus contained and enveloped by a membrane which may appropriately be considered in surface *compression*, as contrasted with the customary surface tension, because adjacent portions of this enveloping membrane tend to move apart from instead of toward each other, in a direction tangential to the surface of curvature. The sphere is the stable form that must be enveloped by a membrane in surface tension, but is no longer stable if its bounding membrane is in surface compression; and this instability is, therefore, in such a case, relieved first by an exhibition of oblateness and later by an out-thrusting of the membrane in the region of smallest radius of curvature, giving rise to the forms observed in a manner entirely predicable by purely geometrical reasoning.

(2) If derived from gas cavities of prolate spheroidal form, the liquid cavities are of forms somewhat like that of those walnuts, occasionally met with, that have three instead of two lunes or boat-like portions composing their shells. This spontaneously formed solid, trilunar, figure has one axis of triad symmetry perpendicular to one plane of symmetry, and is usually of sharpened angle both along its three edge-ribs and especially at the ends of its chief axis, by reason of the outward thrust of its enclosing membrane, precisely as would be predicted by the reasoning noted above. An example of this form is shown in Fig. 2;

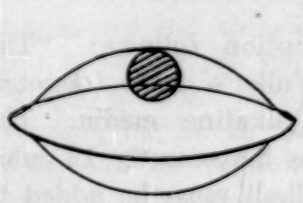

FIG. 1

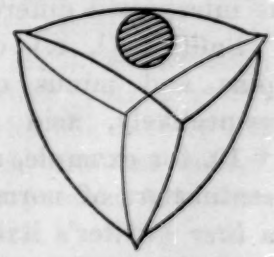

FIG. 2

while Fig. 1 shows the form referred to under (b) above. These figures are from photomicrographs of cavities not more than one millimeter in diameter; and each cavity contains, besides liquid, a small spherical bubble of air, which appears dark.

It is believed that the forms here described and interpreted are unique in inorganic nature.

ALAN W. C. MENZIES
RALPH BEEBE

PRINCETON, N. J.

UNLIKE INTERPRETATIONS OF FULLER'S SCALE IN DETERMINING DEGREE OF ACIDITY

In following directions for making up bacteriological culture media the writer has been impressed by the marked differences in acidity as recommended by different bacteriologists. For example, "The Standard Methods of Water Analysis," adopted by the American Public Health Association, 1917, and commonly used by bacteriologists, recommends the use of culture media of a +1.0 acidty.[1] Smith (4, p. 69), however, apparently recommends a +15.0 agar and a +10.0 gelatin, and these figures are frequently used by plant pathologists in designating the acidity of culture media.

The question which naturally arises is, do bacterial pathogens of plants require in general a much higher degree of acidity than bacteria of milk, sewage, water, animal pathogens, etc., or is it possible to explain this difference by assuming unlike interpretations of Fuller's scale. The writer with the hope of clarifying the situation has compared the descriptions of Fuller's method as given by Smith, whose texts are universally used by plant pathologists, with the description usually presented by bacteriologists, particularly animal pathologists, and also with the description originally presented by Fuller. He finds that Fuller's scale is interpreted differently.

Smith's (l. c.) description follows: "The plus and minus on Fuller's scale denotes, respectively, acid and alkaline media. The +10, for example, means that exactly 10 cubic centimeters of normal alkali must be added to a *liter* (writer's italics) of the culture medium to render it exactly neutral to phenolphthalein, and, correspondingly —10 means that the fluid is alkaline to phenolphthalein and that 10 cc. of normal acid would need to be added to bring 1 *liter* back to the neutral point." He follows this interpretation of Fuller's scale, as amount per liter, in his very recent work (5, p. 106): "Our standard agar is +15 and our standard gelatin +10 on Fuller's scale, or 1.5 per cent. and 1 per cent. respectively, if reckoned on 100 c. c. portions. It is best to keep to Fuller's scale since we make up media in liters, not in 100 c. c. portions."

The following description of Fuller's scale, taken from Park and Williams' (3, p. 102), is typical of the interpretations placed upon this scale by various texts on animal pathogens: "Calculation—Five c. c. of medium require 2.4 c. c. of N/20 NaOH, therefore *100 c. c.* (writer's italics)—would require 2.4 c. c. of N/1 NaOH—; in other words, the medium is 2.4 per cent. acid to phenolphthalein or +2.4 if expressed according to *Fuller's method* or *scale.*" It will be noted that in this interpretation Fuller's scale is used as degree of acidity in *100 c. c.* of medium in contrast to those interpretations in which the scale denotes degree of acidity in *1,000 c. c.* of medium.

Fuller's (1, p. 388) own description reads as follows: "For accuracy and convenience, the expression of acidity or alkalinity of culture media in numbers of cubic centimeters of a normal solution *per liter* (writer's italics) is by far the best, and I recommend its universal adoption as a standard method." Concerning degree of acidity with reference to optimum growth, he says (p. 391): "Speaking in general terms the available data appear to warrant the placement of the optimum degree of reaction within narrower limits, between 10 and 20 of our scale," and (p. 394) he adds, "As it is very urgent that some fixed point be adopted I venture to suggest that for quantitative water analysis . . . . 18 on our scale be taken as a standard. This means, of course, that such a solution would require 18 cubic centimeters per liter of normal alkali to render it neutral to phenolphthalein." This usage, as amount per liter, has been generally adopted by plant pathologists, while the animal pathologists, in general, use the scale as denoting amount per 100 c. c.

It should be pointed out that Fuller does not

[1] Since Fuller's scheme has several decided disadvantages it is being supplanted by more accurate methods. (See Report of the Committee on the Descriptive Chart for 1919. *Jour. Bact.*, 5: 127-143. 1920).

use the plus (+) sign to denote degree of acidity although he does use the minus (—) sign for alkalinity. In a table which shows the relationship of different degrees of reaction to the number of bacteria developed (p. 393) he presents under "reaction" the following figures: 40, 35, 30, 25, 20, 15, 10, 5, 0, —5, —10, —15, —20, —25, adding, "Numbers refer to cubic centimeters per liter of normal acid or alkali necessary to change it to phenolphthalein neutral point. Minus (—) means an alkaline solution." The plus (+) sign was apparently not used by Fuller, the figure itself without any sign standing for acidity. While the writer has not definitely ascertained when and by whom the plus (+) sign was first used, it is probable that it was first brought into general use by the *Report of the Committee of Bacteriologists of the American Public Health Association* (2) in 1898. This committee, of which Fuller was a member, made the following recommendation (2, p. 75): "Manner of expressing the degree of reaction of culture media: Since at the time the reaction is first determined culture media are more often acid than alkaline, it is proposed that acid media be designated by the plus sign and alkaline media by the minus sign, *and that the degree of acidity or alkalinity be noted in parts per hundred*" (writer's italics). "The bulk of available evidence from both Europe and America points to a reaction of +1.5 as the optimum degree of reaction for bacterial development in inoculated culture media" (p. 76).

It is quite evident that animal pathologists and bacteriologists in general have substituted for the methods proposed by Fuller those proposed by the Committee of the American Public Health Association of 1898, although they usually cite or designate Fuller's scale, while plant pathologists use Fuller's original recommendations with the exception of adding the plus (+) sign to indicate acidity.

Since +10.0, +15.0 in 1,000 c. c. of the medium correspond to +1.0, +1.5 respectively in 100 c. c. of the medium it is evident that the degree of acidity recommended for plant pathogens corresponds to the acidity recommended for bacteria in general, and it is necessary to know the author's interpretation of Fuller's scale when considering the degree of acidity described or recommended.

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UNIVERSITY OF ARKANSAS

(1) FULLER, GEORGE W. *On the proper reaction of nutrient media for bacterial cultivation.* Jour. Amer. Pub. Health Asso., 20: 381-399. 1895.

(2) *Report of a Committee of Bacteriologists to the Committee of the American Public Health Association on the Pollution of Water Supplies.* Jour. Amer. Pub. Health Asso., 23: 56-100. 1898.

(3) PARK, W. H., and WILLIAMS, A. W. *Pathogenic microörganisms.* Lee & Febiger, publishers, Philadelphia, 1920.

(4) SMITH, ERWIN F. *Bacteria in relation to plant diseases.* Vol. 1. Published by the Carnegie Institution of Washington. 1905.

(5) SMITH, ERWIN F. *An introduction to bacterial diseases of plants.* W. B. Saunders Company, publishers, Philadelphia, 1920.

THE AMERICAN CHEMICAL SOCIETY

(Continued)

DIVISION OF RUBBER CHEMISTRY
W. W. Evans, *chairman*
Arnold H. Smith, *secretary.*

Report of committees, executive, physical testing, abstract, chemical analysis and accelerator.

Mineral rubber: C. O. NORTH. The purpose of this paper is to bring out the desirable and undesirable properties of M. R. in order that M. R. makers will appreciate more fully how their product is employed. Changes in stress strain relations, hysteresis losses, permanent set, energy of resilience and abrasion with increase in M. R. ratio to rubber are shown. M. R. is essentially a plastic material. When a stock containing it is stretched, the M. R. flows with the rubber. On release the M. R. flows back with the rubber. The principal evidence of its presence is a slowing up or logging of the return.

The Tetra-hyroxyphenyl derivative of rubber and its tetra-methyl ether. HARRY L. FISHER AND HAROLD GRAY. The tetra-phenoxy derivative of rubber described by Weber (ber. 33, 791) is shown to be the tetra-hydroxyphenyl derivative not only by the method of formation, and by its solubility in aqueous NaOH, but especially by the

fact that it can very readily be methylated to the corresponding tetra-methoxyphenyl derivative. The reaction for preparing the hydroxyphenyl compound from rubber tetrabromide and phenol is like a Friedel-Crafts' reaction, being speeded up by the use of anhydrous aluminum chloride, zinc chloride, etc. Other halogen derivatives of rubber such as the dihydrochloride also react with phenol.

Microscopy of rubber fillers. IRENE C. DINER. The principal rubber fillers, namely, barytes, whiting, zinc oxide, lithopone, litharge, red lead, antimony sulphide, iron oxide and gas black, are included in a large chart showing the characteristics which differentiate these microscopically. Among the properties shown are size, color, shape, crystal structure, impurities and optical properties. A basis of a positive method of identification of the fillers is indicated, based upon 17 different measurable physical properties. It is hoped that this method will in time supercede the present lengthy and cumbersome qualitative and quantitative analysis. Besides being shorter it is more exact since it gives the exact state in which the filler is present rather than merely the amount of each element with a good guess as to their association, for example, whether the substance be present pure or impure, hydrated or anhydrous, etc.

The use of the microscope and photomicrographs in the study of inorganic materials used in rubber. BENTON DALES AND W. W. EVANS.

Recent developments in the art of rubber microsectioning. HENRY GREEN. A method for making microsections of rubber has been developed which is free from the various inconveniences associated with the method heretofore employed of freezing the sample with CO_2 and liquid air. The elasticity is destroyed and sufficient rigidity acquired by treating the sample with dilute SC_1 solution. Sections are obtained ½ mm x 4 mm in area, which under a magnification of 1,500 diameters appears, in round numbers, to be a strip 3 ft. wide and 20 ft. long. This is sufficient to show all the characteristics of the sample. The sections can be made exceedingly thin, beautifully transparent and of uniform thickness.

Piperidine-piperidyl-dithiocarbamate as a rubber accelerator in the presence of zinc oxide: G. S. WHITBY AND A. H. SMITH. One part of piperidine-piperidyl-dithiocarbamate in a 90 rubber 10 S, 10 zinc oxide mix cuts the time of vulcanization at 141 degrees C from three hours to less than one minute. At 131 degrees C it cuts the time of vulcanization from seven hours to one minute. It is fully vulcanized in three to four minutes at 115 degrees. When only two parts of S are used the time of vulcanization is one minute at 141 degrees, or two minutes at 131 degrees, or ten minutes at 115 degrees. Stress-strain data are given.

An improved oven for accelerated aging of rubber. C. W. SANDERSON.

General discussion. *Accelerated aging tests.* Led by W. W. Evans, review of article, *Ten years experience with accelerated aging tests,* by W. C. Geer and W. W. Evans.

An apparatus and method for abrasion tests on rubber compounds: J. C. SPROUL AND W. W. EVANS.

The determination of true free sulfur and true coefficient of vulcanization in vulcanized rubber: W. J. KELLY. The application of the method devised for pure gum stocks (J. Ind. Eng., Ch. 12: 875, 1920) to compounded stocks. Free sulfur determined by the 'satured alcohol'' method. For combined sulfur the sample is extracted with alc. KOH and ether HCl, the latter removing any sulfide as H_2S and dissolving accelerators which form water on ether soluble hydrochlorides. In this way considerable sulfur is removed in addition to that extracted by acetone and which had previously been considered as combined with the rubber. In some cases an additional extraction with water is necessary, but the details of this remain to be worked out.

Corrected stress-strain curves for rubber: J. W. SHIELDS. An improved method is explained for drawing stress-strain curves for rubber which takes into account the decrease in cross section of the specimen. Such curves do not have the S shape which is characteristic of uncorrected curves. The corrected curves show the modulus of rubber to be least at the smallest elongation and to increase gradually as the specimen is stretched. The method for determining the true modulus of unstressed rubber is illustrated. The equation for this curve is developed and the values of the equation constants given for several stocks.

The determination of the particle size of pigments. W. W. VOGT. By a turbidimetric method it is possible to determine the capacity of a pigment to extinguish direct light rays. This capacity, called obscuring power, is a direct function of the average particle size of the pigment. The values of O. P. are shown to be consistent with particle size as determined microscopically and furthermore to be in close accord with the practical compounding value of the pig-

ment. Hence, by the determination of the O. P. of an unknown pigment it is possible to predict what its practical compounding value will be in relation to known pigments.

The solubility of sulfur in rubber: C. S. VENABLE AND C. D. GREEN. Values have been obtained for the solubility of sulfur in rubber at 55°, 75°, 95° C. The procedure used was essentially to pack thin rubber strips in sulfur, maintain at the desired temperature until equilibrium was reached, and then analyze for combined and free sulfur. Various precautions were adopted to insure that equilibrium was reached. It was found that the solubility of sulfur in rubber increases slowly with the vulcanization coefficient, this increase being more rapid as the temperature increases. It was found that when this coefficient was greater than 7 per cent. combined sulfur, it was impossible to obtain solubility values by the method used due to the fact that the rubber becomes almost impermeable to free sulfur. This impermeability probably has more to do with the non-blooming of hard rubber stocks than the increased solubility of free sulfur. By extrapolating the curves obtained, it can be calculated that a stock having 4 per cent. combined sulfur at 140° C will be saturated with about 15 per cent. free sulfur.

Reactions of accelerators during vulcanization. IV. Mechanism of the action of zinc compounds: C. W. BEDFORD AND L. B. SEBRELL. Zinc sulphydrate vulcanizes rubber in the presence of sulfur at ordinary temperatures. Zinc persulfides are stable compounds and vulcanize rubber in heat cures far more rapidly than ordinary sulfur. Zinc salts of organic accelerators form polysulfides without decomposition into zinc sulfide and disulfides. Disulfides are changed to mercaptans by hydrogen sulfide and in the presence of zinc oxide they form zinc salts. (An answer to Bruni, *India Rubber J.*, 62 [1921] 63.)

The action of volatile organic solvents and vulcanizing agents on organic compounding materials and resinous gums: FREDERICK DANNERTH. The purpose of this investigation has been to obtain fundamental data for the industries which use plastic masses. The amount of matter soluble in certain liquids at stated temperatures has been studied. We have also noted: The amount of a given solvent which will mix with any other given solvent at a given temperature; the swelling action of certain solvents on stated organic materials; the action of certain vulcanizing agents on pitches and oils as well as their action on chicle, balata, guttapercha and jelutong. The influence of the product has been studied, first using only organic compounding material and secondly using only the resinous gums.

The preparation and testing of crude rubber: O. DE VRIES.

SECTION OF CELLULOSE CHEMISTRY

Harold Hibbert, *chairman.*

G. J. Esselen, Jr., *secretary.*

Acetolysis of spruce pulp. Preliminary communication: WALTER RUSSELL AND LOUIS E. WISE. Acetolysis of spruce sulfite pulp, when carried out as in the case of acetolysis of cotton, yields appreciable amounts of cellobiose octaacetate. The yield of cellobiose appears to depend on the normal (Alpha) cellulose content of the pulp, rather than on the so-called "total cellulose." The cellobiose reaction furnishes another link in the chain of evidence that the normal cellulose of spruce wood is chemically similar, if not identical with that of cotton.

Studies on cellulose chemistry. III. The constitution of cellulose: HAROLD HIBBERT. The recent work of Karrer and of Freudenberg on octacetylcellobiose confirms the view advanced previously by the writer that the ratio of this product to dextrose pentacetate obtained from the decomposition of cellulose acetate is much higher than corresponds to the pentaglucosidylglucose formula for cellulose put forward by Hess. The results cast considerable doubt on the correctness of his formula, but, on the other hand, are in no way in disagreement with that advocated by the writer. Further evidence in support of these is to be found in the recent paper of Denham on the methylation of cellulose.

IV. The action of HBr on carbohydrates and polysaccharides: HAROLD HIBBERT AND HAROLD S. HILL. Cellobiose gives a yield of 27 per cent. of bromomethylfurfuraldehyde while lactose gives less than 7.0. These two derivatives are structurally identical and there is thus the possibility of utilizing this reaction for the determination of configuration. The mechanism of the reaction is being carefully studied in view of its bearing on the constitution of cellulose.

The condensation of citral, with certain ketones and the synthesis of some new ionones: HAROLD HIBBERT AND LAURA G. CANNON. The best method for purifying citral is the one developed by Tiemann. Of the condensing agents hitherto employed, sodium ethylate is the most satisfactory, but metallic sodium is equally efficient. Better yields of a purer product have been ob-

tained. The bisulfite method of purification is capable of general application in the purification of pseudo-ionones, giving yields of about 85 per cent. and chemically pure products. New ionones have been synthesised from methyl propyl ketone and acetophenone.

The rôle of celluloses in plant life: R. W. THATCHER. Celluloses are classified according to their chemical composition into three groups: the hemi-celluloses or pseudo-celluloses; the normal celluloses; and the compound celluloses. Hemi-celluloses are amorphous polysaccharides which are probably reserve carbohydrates deposited in the structural, or cell-wall, materials rather than in storage organs. Normal celluloses are amorphous forms of polysaccharides having an empirical formula similar to that of starch; but exhibiting a characteristic fibrous structure instead of the granular structure characteristic of starches. They are true cell-wall, structural material; they can be hydrolyzed by certain bacteria but probably have no nutritive function in higher plants. Compound celluloses are either colloidal complexes or definite chemical compounds of true cellulose with some encrusting material which serves to stiffen and harden the celullar structure and convert it into "wood." They are among the most inert plant compounds and probably have no role other than that of adding strength and stiffness to the stems or other tissues of plants.

The determination of the "bromine figure" or "chlorine factor" of pulp and the utilization of these quantities in bleaching: ALFRED TINGLE. The extent to which bromine solutions, approximately decinormal, act on cellulose and on unbleached sulphite spruce pulp, has been investigated. Accurate measurements could only be made when the material was brought into solution before treatment with bromine. Under the experimental conditions used, it was found that bromine did not act on cellulose to any appreciable extent in an hour, but that it acted on unbleached sulphite pulp in stages, one of which was completed in 30 minutes. From measurements of this action a quantity was found, constant for each sample of pulp, which bears a definite and simple relation to the chlorine-consumption in bleaching the pulp.

The alleged absorption of aluminum from solutions of aluminum sulphate by cellulose: ALFRED TINGLE. Both neutral and basic solutions of aluminum sulphate were brought in contact under various conditions with cellulose in the form of (*a*) acid-washed filter paper, (*b*) bleached sulphite spruce pulp. By the methods employed, no change in the aluminum content of the solutions could be detected, except when a pulp was used which contained calcium compounds and gave a strongly alkaline reaction to water, with which it was extracted. The deduction is made that absorption does not occur to any appreciable extent, and that the phenomena which have been accounted for by this cause are due to other causes.

The distillation of methoxyl groups in wood distillation products: L. F. HAWLEY AND SUBRAMANYA AIYAR. It has been reported that the treatment of wood with sodium carbonate previous to distillation increases the yield of methyl alcohol. The source of this increase has now been determined. Maple wood containing 6.09 per cent. methoxyl when distilled gave products with percentages of methoxyl as shown in column 1 of the table. On distilling the wood after treatment with 1 per cent. sodium carbonate the methoxyl distribution is as shown in column 2 of the table and the increase of methyl alcohol is seen to come partly from the dissolved tar and partly from the charcoal. The proportion of total methoxyl in the original wood recovered in the distillation product remains about the same.

PERCENTAGE OF METHOXYL BASED ON THE WEIGHT OF THE WOOD DISTILLED

	Original wood.	Wood treated with Na_2CO_3
Charcoal	0.285	0.044
Settled tar	0.517	0.588
Dissolved tar	0.303	0.173
Pyroligneous acid	1.617	1.953
Gas (methane)	1.306	1.468
Total	4.028	4.226

Acetic ether as a solvent for nitro cellulose and cellulose acetate: H. F. WILKIE. In discussing acetic ether as a solvent for nitro cellulose and cellulose acetate a review is made of the subject of cellulose esters solvents in general. The production of high grade anhydrous ethyl acetates or acetic ether as the pure product is designated and results obtained in experimenting with it as a solvent of cellulose esters point to the strong possibility of it taking the place of amyl acetate. It can be procured in large quantities and the ultimate supply is unlimited. Data is given to support the following claims: It is neutral in reaction and remains so on long exposure to air, light or moisture, and is non-hydroscopic. Acetic ether is a powerful solvent of nitro-cellulose and a good solvent for cellulose acetate. It works

well in combination with the other well known solvents and non-solvents, and is a pure substance which evaporates without residue and at a uniform rate, giving rise thereby to homogeneous films. By a very important property it possesses of forming various constant boiling mixtures (especially one with water) more volatile than itself it combines with the advantages of its low boiling point the ability to act as the high boiling solvents in overcoming the evil effects of water absorption.

Requirements of a brief, critical monograph on the chemistry of cellulose: LOUIS E. WISE. The article outlines the type of material and data that should be incorporated into a monograph on cellulose. Many of the older terms that still appear in the cellulose literature should be deleted or redefined. Proper weight should be given to carefully selected fundamental data and to the work of critical investigators. All hypotheses dealing with the constitution of cellulose or its derivatives should be subjected to close scrutiny, and those based on good experimental data should receive emphasis. Recent work on the colloidal properties of cellulose should be included. The monograph besides being critical should be suggestively written so as to stimulate research. A brief volume with a good bibliography appears to be more desirable than a series of monographs.

SECTION OF PETROLEUM CHEMISTRY

T. G. Delbridge, *chairman.*

W. A. Gruse, *secretary.*

An unusual type of casinghead gasoline: C. E. COATES AND B. Y. TIMS. The Terrebonne gas field, which is situated about twenty miles below Houma, Louisiana, gives gas and a pressure of about 1,200 pounds per square inch. This gas is piped to Houma and supplies the town and vicinity with fuel. The pipes are provided with drips which fill up rather frequently and are pumped out. As the condensate did not seem to be like ordinary gasoline either in odor or boiling point a sample was investigated with the following results: Boiling began at 195° C. The fractions first obtained were refractionated and eventually obtained with fairly constant boiling points. The lowest fraction had a formula $C_{12}H_{22}$. The higher fraction seemed to belong to the same series. The condensate contained no members of the parafine series at all, but probably is made up of dicyclopentyl and its homologues.

Some observations on the polymerization of amylene: THOS. MIDGLEY, JR., AND G. W. HANK. The action of dilute and concentrated sulfuric acid and of heat on the polymerization of amylene has been studied in some detail, and a chart of polymerisation reactions is presented. It is suggested that di- and tri-amylene have cyclic structures. The subject is of interest in connection with the gumming of cracked gasolines.

The iodine and bromine values of petroleum products: E. M. JOHANSEN. A number of petroleum products were examined, the results being recorded in numerous tables. It was shown that the total iodine or bromine values do not correspond to the relative unsaturation of petroleum products, as only a part of the absorbed halogen is combined by addition. As the Hanus solution does not permit the separate determination of this part, solutions of bromine or bromine and iodine in carbon tetrachloride were used, by aid of which the desired addition values were obtained. The influence of varying experimental conditions upon the reactions were studied. It appears that the absorption of bromine is less affected by the variations than that of iodine. A bibliography of the literature on the subject was compiled.

Specific heats and heats of vaporization of motor fuels: ROBERT E. WILSON AND D. P. BARNARD, 4TH. The authors present the results of a series of observations on the total sensible heats of completely vaporized motor fuels. These, combined with critically compiled data from the literature on heats of vaporization of motor fuels, make it possible to draw accurate total heat curves over the whole range of temperatures up to 500° C. and derive fairly accurate values for the specific heats of the hydrocarbon vapors. Combinations of this with vapor pressure data make it possible to determine just how hot the air or the fuel must be preheated in order to completely vaporize the motor fuel in a carburetor.

Further observations on the value of the R. E. test: C. H. OSMOND AND T. G. DELBRIDGE. Data are given showing that the R. E. test distinguishes between some oils which give the same results by other emulsification tests. Criticisms of the method as published in the A. S. T. M. Proceedings for 1920 have led to minor changes in the method and particularly in the interpretation of the readings. Further precautions are given, also explanations of some of the procedure. Modification of the test for application to oils of very low viscosity is also given.

The inversion of phases in oil-water emulsions: LEON W. PARSONS. A broad survey has been